

## **Executive Summary**

The maritime mobile frequency band supports maritime communications worldwide. Appendix 18 of the ITU Radio Regulations (RR) defines the channels of the maritime mobile service. These channels support a variety of communication functions including: public correspondence, intership and ship-to-coast, coast- to-ship, port operations, calling and various safety purposes. Safety functions include distress, search and rescue, ship movement, navigation (bridge-to-bridge) communications, and maritime safety information broadcasts.

Additional maritime mobile channels are required to meet the growing demands for the above services in the near future, particularly the demand for digital services. To accommodate the old and new services demand for additional channels, the maritime mobile spectrum needs to be used more efficiently. Narrowbanding of the maritime mobile VHF band from 25 kHz to 12.5 or 6.25 kHz channel bandwidths is one possible solution to make more channels available. However, any technique must take into account factors such as continuing to make low-cost transceivers available to the general boating public and preserving interoperability with existing 25 kHz FM equipment. They must also consider the time period in which these targeted improvements can be achieved. Furthermore, any new technology used to reduce spectrum congestion and improve spectrum efficiency must be able to accommodate existing safety and distress communications.

The United States plans to submit a proposal in the upcoming 1997 World Radio Conference (WRC -97) to permit narrowbanding the maritime mobile VHF band. To support that proposal, the United States Coast Guard and the National Telecommunications and Information Administration (NTIA) conducted bench and radiated tests of 25 kHz (referred to as wideband) and 12.5 kHz (referred to as narrowband) channelized marine radios. Commercial and recreational grade wideband and narrowband radios were tested for susceptibility to intermodulation products and adjacent/interstitial channel interference, and for interoperability. The narrowband radios were prototype commercial grade radios that were not fully optimized for narrowband operation. In addition, a VTS ship transponder receiver (as defined in ITU-R M.825) was tested for susceptibility to adjacent channel interference.

The results of the intermodulation tests showed that commercial grade radios are less susceptible to intermodulation products than the recreational grade radios. The results of the adjacent/interstitial channel interference tests showed that the narrowband radios were less susceptible to adjacent /interstitial interference than the wideband radios, both commercial and recreational grade. The results of the VTS ship transponder tests showed that the transponder receiver performed well in the presence of adjacent channel interference. The results of the interoperability tests showed that the wideband radios are fully interoperable with narrowband radios, with a slight degradation in the operating range of a wideband receiver.

Although the results of the tests showed that the wideband and narrowband radios are interoperable, introducing narrowband radios into the existing 25 kHz environment must be carefully done to minimize the effects of adjacent channel interference on wideband receivers. This is especially true when the narrowband radio is operating on an interstitial channel  $\pm 12.5$  kHz off-tuned from a regular 25 kHz channel. One method that would help, but not totally eliminate, adjacent channel interference is to ensure geographic separation between adjacently tuned narrowband radio transmitters and wideband receivers. However, this may not be achievable in the entire maritime band due to the fact that most of the frequency channels in the band are not exclusively assigned but shared among a variety of users in the band. Initially, implementing separation distances to allow narrowband operations could be done by those maritime users that have greater control over who uses their services and who can afford narrowband capable equipment.

The range of distances that would be needed for geographic separation for adjacently tuned wideband and narrowband radios were calculated based on data from the bench tests. The results show that for 12.5 kHz of frequency separation from a 25 watt transmitter, the wideband radio required about 12 nmi of separation and the narrowband radio required about 6 nmi of separation to satisfy the test requirements. These results indicate that the narrowband radio was more immune to adjacent channel interference than the wideband radio. The aforementioned separation distances assume minimal degradation in receiver sensitivity for the mobile units. Operational base stations should observe larger separation distances, especially if the working frequencies with mobile units are simplex. Interoperability distances based on data from the bench tests showed that the wideband receiver lost about 3 nmi of operating range when communicating with a narrowband radio, as compared to a wideband radio. The narrowband receiver did not suffer any degradation in operating range when communicating with the wideband transmitter, as compared to communicating with a narrowband transmitter.